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Summer 2013

International GCSE Further Pure Mathematics (4PM0) Paper 2

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General Comments

Students generally found this paper accessible. Almost all questions provided something for all students.

Students need to be reminded of the need to show sufficient working in case the answer they provide is incorrect. Correct answers obtained from a calculator usually qualify for full marks, but without full working being shown, incorrect answers cannot qualify for any marks on that part of a question. It is good practice to quote general formulae before substituting numbers. Incorrect substitution can still lead to some marks being gained as quoting a correct formula and substituting satisfies the general condition of "knowing the method and attempting to apply it" which has to be demonstrated before an M mark can be awarded. This would apply even to basic formulae such as the one for solving a quadratic equation.

There are still cases seen where students have used a previously obtained rounded answer in a subsequent calculation. Sometimes using, for example, an answer rounded to three significant figures in subsequent working will give the same three significant figure result for a later answer as using the non-rounded value does but frequently it does not. Such cases of premature approximation are always penalised. This can be avoided by initially writing down at least four figures for the first answer and then rounding as instructed; this way the more accurate answer is still available should it be needed later on in the question.

Question 1

Most students could use $\frac{1}{2}ab\sin C$ correctly to obtain the area of the triangle but not all remembered to round their answer to 3 significant figures as demanded in the question. In part (b) very few students realised that they were dealing with the ambiguous case. The majority could use the cosine rule to get a correct length for BC and then used the sine rule to obtain $\angle B = 71.3°$ but then did not give any consideration to the triangle itself, so did not realise that B had to be the largest angle and could not be 71.3^{o}. Students who use the cosine rule a second time in questions such as this automatically get the obtuse angle - a reward for the more complicated algebra needed.

Question 2

In general students' log work in part (a) was very good. If they did make errors in this question it was usually when changing base. A majority of students were successful. The most popular approach was change $\log_4 x$ to $\log_2 x$ by various methods, mostly successful. The less able students did get confused between addition and multiplication and demonstrated little understanding of the manipulation of logs. Many students realised that they needed to change the base of the logs, and most opted to change to base 2. A minority changed to base 4 or base 10. Other approaches included changing to base x and y and then back to base 2.

A common error was to multiply by 2 instead of divide by 2 when changing to base 2. Those that opted to use base 2 tended to make better progress at this point as the numbers and expressions involved were easier. Generally students were able to combine logs and undo logs. Some students found this question quite challenging and were unsure about how to approach it.

Students found part (b) much easier, and many students gained full marks here. Usually the only way this went wrong was if students ignored the given $x = 8y$ and used a relationship between x and y from incorrect log work in part (a).

Question 3

In part (a), the integration of $\frac{2}{x^2}$ caused some difficulty, sometimes with the power and sometimes with the sign. Some students did not show the substitution fully. As this was a "show that" question it was essential that all steps in the working were shown fully. In part (b) most of the incorrect solutions seen were due to differentiating the sine instead of integrating (shown by multiplying cos $2x$ by 2 instead of $\frac{1}{2}$) or using the incorrect sign.

Question 4

Many students gained the mark for part (a). The vast majority knew the correct formula to apply although summation formulae appeared more than once. Many students were able to gain the first mark of part (b). Some then were unsure how to simplify and solve their equation and thus were unable to gain further marks. Only the most able students stated that $r > 0$ and so rejected the negative root. Students should be advised that in a "show that" question all decisions made need to be justified. When students reduced the expression to a quadratic most were able to apply the quadratic formula correctly and obtained a correct expression
for r. Most successful students showed sufficient working, but some were a little brief, given that this was a "show" question. In part (c) most students used the calculator and found r^3. These students tended to gain full marks. A minority attempted the expansion of r^3, with varying levels of success. A common error was to cube the 2, the 1 and the $\sqrt{5}$. Very few students found t_3 to be equal to $t_1 + t_2$

Question 5

Errors in part (a) were mostly for including an extra $2x$ or giving the whole circumference of the circle instead of just the semicircle. Part (b) was mostly correct provided a correct expression for y had been found in (a). Many students who struggled with parts (a) and (b) continued successfully with part (c). However, some forgot to calculate the maximum area or did not establish that they had obtained a maximum area and not a minimum one. Most who did establish the maximum used the second derivative method. Consideration of the sign of the first derivative is only acceptable if numerical calculations on either side of the turning point are given. Very few adopted the quickest method in this case - stating that the graph of the function is a quadratic with a negative coefficient of x^2 and so has a maximum point. A sketch is a quick alternative to words. Some students lost the final A mark as they did not round their answer as instructed.

Question 6

This was an accessible question usually resulting in students scoring 5 or 6 marks. Almost every student realised what they had to do and used correct methods to try to achieve this. In part (a) the majority of students gained full marks. Most showed sufficient working, but some substituted $p = -2$ into the expression but then showed no further calculations, thus losing the A mark. Most students make a good attempt at part (b), and were able to gain full marks. Most realised that $(x+2)$ was a factor and either divided to find a quadratic or did so by inspection. Common errors included omitting the -2, and making a sign error in finding the factors or applying the formula.

Question 7

Most students completed the table in part (a) correctly, although some did not round their answers as demanded. In part (b) there were many plotting errors seen - for example 1.51 was often plotted at 1.6. Smooth graphs were usually drawn through the plotted points though some had extra bends due to previous errors. Many students did not proceed to use their graphs to solve the equations given in parts (c) and (d). Some students managed the algebraic manipulation required in part (d) but then were unable to draw the correct straight line or did not round their answer.

Question 8

In part (a) the majority were able to find the gradient successfully. The less able students did obtain -2 by making $3y$ the subject or stated the gradient was 2. Most students were then able to find the equation of a perpendicular line. The majority knew how to find the perpendicular gradient, and used $y - y_1 = m(x - x_1)$ as the preferred method. Many were able to gain full marks, although some then made some errors in trying to rearrange the expression. In part (c) students knew what they should do and the majority successfully solved their simultaneous equations; for most students this gave the correct coordinates for Q. Students made a good attempt at trying to solve the simultaneous equations and, provided their answer to (b) was correct, were often able to gain full marks for (c). Many correct answers seen for part (d). Even those who had gone wrong in (a) were able to use their gradient appropriately. In part (e) many students were able to gain the first B mark for finding $x = -3$. Although many were able to use a correct method to find the length of the sides, some students thought they were trying to show that they were perpendicular and tried to compare gradients. Students found this part of the question quite challenging partly because it depended on earlier work. Most students did not seem to realise that they were dealing with a square. Very few used $PQ \times QR$ to find the area. The most successful approach was to use the "determinant" method. Most of the students who used this method were able to apply it correctly although some did not repeat the first pair of coordinates at the end. Errors occurred in trying to find the coordinates of S. Many tried to find the midpoint or thought it was where l_2 intersected the y-axis. Other successful approaches included an attempt to find PR and then the areas of two triangles or the area of a rhombus, an attempt at the area of a kite or even an attempt at the area of a trapezium.

If parts (a) and (b) caused problems students did not get very far. However, most were able to attempt the simultaneous equations in part (c) and then knew how to show that $PQ = QR$ in part (e).

Question 9

Part (a) was mostly well answered with errors stemming from failing to keep track of the number of negative signs in various terms of both expansions. Most attempts at part (b) produced a correct answer. In part (c) few students realised that part (b) was intended to give a quicker solution by adding the expansions instead of multiplying them. However, most could multiply their expansions correctly and most errors were due to earlier mistakes when obtaining their expansions. It was rare to see a correct statement in (c)(ii). Students mostly realised that part (d) required them to integrate their expansion from (c).

Question 10

Most sudents were able to gain the first M mark in part (a) and many also gained the A1. Some students gave decimal answers and so lost the A mark. Although some found part (b) challenging, many were able to find an expression in $\tan\frac{t}{2}$. Most students preferred to work with the acute angle but many were unable to then use this to find an appropriate positive angle *t*. Many students also used their calculator and obtained a negative value for *t*, but were unable to find an appropriate positive angle, thus losing the last M1A1 marks. In part (c) the majority realised the link between displacement and velocity and attempted to differentiate. Some integrated and some even used speed = distance/time. Many fully correct answers were seen in part (d). Using a compound formula was overlooked by some but those who made the connection usually got 2/2. Where students had not gained the marks in part (c) they were rarely able to make much progress in part (d). Students who had struggled with the earlier parts in this question were often able to make a good attempt at part (e). Sign and operation errors left many students with at most 2/4. Common errors were to use degrees instead of radians. Many students seemed to like to work with degrees, and of those some realised they needed to work with radian quantities and converted to radians in the answer. However, some students added radian values to degrees, and so lost the last two marks. Many students were able to find the first value for *t*, but fewer were able to obtain a correct value for *t* in the range 2π to 4π. Not many students omitted part (e) entirely even though it was the last part of the last question and many students completed it successfully.

Grade Boundaries

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